GUIDE TO WEED CONTROL FOR WILD BLUEBERRY PRODUCTION IN ATLANTIC CANADA

Published by authority of the
ATLANTIC PROVINCES AGRICULTURAL SERVICES COORDINATING COMMITTEE

Factsheet No.
ACC1014
Agdex No. 235/641
Revised 1999

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INTRODUCTION

The weed flora in blueberry fields is unique compared to that found in cultivated fields. Producers are dealing with a native perennial crop in low pH soils, where there is no associated tillage nor cultivation. Most of the problem weeds encountered in lowbush blueberry fields are perennials. However, annual and biennial weeds may also be present. Weeds which prefer low pH soils and the same habitat as blueberries thrive if not controlled.

The history of a field often determines its weed flora. Fields developed from abandoned hayfields or pastures typically

have a large number of grasses and herbaceous perennial weeds. Fields developed from woodland, however, often have plants commonly associated with the woodland undergrowth such as bunchberry, as well as perennial bushes and shrubs.

To successfully develop a weed control program, it is important to identify the weeds, understand their life cycle and have an appreciation of why particular weeds grow in particular areas.

WEED BIOLOGY

The life cycle and reproductive strategy of a weed species are important factors to consider when planning a weed control program. Weeds can be classified an annuals, biennials or perennials. Weeds can additionally be classified as grasses, broadleaf weeds, ferns, herbaceous or woody weeds.

Annuals

Annuals complete their life cycle from seed in less than one year. There are two types: summer and winter annuals. Summer annuals germinate in the spring, mature, produce flowers and seeds and die before fall. Winter annuals germinate in the fall, overwinter in a seedling or rosette stage, mature, produce flowers and seeds, and die in the spring or early summer. Because of the seedling stage, annual weeds are generally easy to control. There are usually few annual weeds present in lowbush blueberry fields.

Biennials

Biennials generally complete their life cycle over two years. The first year the seeds germinate and form a basal cluster of leaves and a tap root. The plant overwinters in this stage. During the second year the weed produces a flower stalk, set seed and dies. Examples of biennial weed are evening primrose and wild carrot. Biennial weeds are rarely observed in blueberry fields.

Perennials

Perennials weeds live for more than two years. These weeds are the most common in blueberry fields and generally the most difficult to control. Perennial weeds may reproduce primarily by seed (daisy); by both seed and roots (sheep sorrel); or primarily by vegetative means (bunchberry). Many perennial weeds grow in the same manner as the blueberry plant. Therefore, many of the production practices that promote blueberry growth (e.g. pruning) also promote growth

of these weeds. Perennials which are low growing and spread vegetatively by interconnected underground root systems are the most difficult to control. Perennial weeds growing above the blueberry plants may be controlled by wiping or applying spot treatments of registered herbicides. Perennial weeds include both woody and herbaceous species.

Woody plants
Woody plants can be classified as any plant which develops woody tissue. This may include brush, shrubs, trees and woody vines. Herbaceous plants are those that are not woody.

Broadleaf Weeds
Broadleaf weeds are annual, biennial or perennial plants which generally have two leaves (cotyledons) emerging upon germination. The leaves normally have a branching network of veins and the flowers have distinct petals.

Grasses, Sedges and Rushes
Grasses can be annual or perennial plants. They generally have narrow, upright, parallel-veined leaves. Grasses have jointed stems, usually hollow at the internodes and are circular in cross section.

Sedges are a large group of perennial (rarely annual) grass-like plants which are common in wet, poorly drained soils. Sedge stems are generally triangular in cross section, solid, and not jointed.

Rushes are annual or perennial plants similar in appearance to sedges with grass-like tufted leaves common at the plant base. Rush stems are hollow, circular in cross sections, and not jointed. Like the sedge, this plant is also common in wet areas or poorly drained soil, but is also found in woodland and open fields.

Ferns
Ferns are primitive perennial plants that do not produce flowers and seeds. Ferns consist of a leaf or frond, a stalk, and an expanded blade which may then be further subdivided several times. Ferns spread by long creeping rhizomes and/or by spores.

BEST MANAGEMENT PRACTICES

One way blueberry growers can respond to environmental pressures in a proactive manner is to adopt Best

Management Practices. Best Management Practices are recommendations and guidelines to help growers make sound environmental decisions in their farming operation. They are a combination of management, cultural, and structural practices that are considered to be effective and economical in controlling problems without disturbing the quality of the environment. They provide opportunities for growers to evaluate their own operation and choose the best management practices that are most appropriate for their own situation. It is important to keep in mind that many of the production and management activities that blueberry growers practice influences not just themselves but their neighbours and community. Anything that can be achieved to prevent environmental pressures will make their own operation and the blueberry industry more sustainable.

It is important that growers identify problem areas within their operation and select and implement the appropriate changes. Examples of Best Management Practices that should be considered where appropriate include:

- scout fields and spray only when and where necessary
- match appropriate herbicide rates with soil type
- do not apply herbicides within 50 m of water
- do not mix or load near water, bring the water to the sprayer
- do not apply herbicides to rock formations and exposed ledges as they may provide a direct channel to groundwater
- avoid spraying if heavy rainfall or high winds are forecast
- use an anti-backflow device when filling sprayers from a water source to prevent contamination from backflow
- make sure your sprayer or spreader is calibrated properly and accurately
- leave an untreated vegetation strip near any water sources to act as a filter
- read and follow all instructions as stated on the labels

These are a few examples of Best Management Practices to consider within your own blueberry operation. It is critical for growers to re-evaluate their operation and look for ways to reduce and improve upon any environmental pressures.

NON-CHEMICAL WEED CONTROL

Non-chemical methods of weed control have not generally been used alone but are often used prior to or following other treatments to further enhance control.

One common production practice utilized by blueberry producers is pruning by fire or mowing. Although the main purpose of pruning is to rejuvenate blueberry plants, it also aids in weed control. Burning will control coniferous species and some shallow rooted grasses. The top growth of many deciduous saplings are generally killed by burning but underground parts may resprout, indicating the need for additional control measures. Burning also helps prevent the return of many weed seeds from mature plants to the soil, and will kill many of the weed seeds present near the soil surface. Frequently however, only partial or erratic control results. Burning or mowing alone may promote growth of many perennial weeds with extensive underground root systems.

Mowing and cutting are useful, particularly on weeds higher than the blueberry plants. Weeds must be mowed or cut several times during the season to ensure suppression. Species such as maple, birch and willow should be cut back to ground level. Regrowth from the roots usually results, and should therefore be cut again. Species cut in June, July and August for a few seasons will help ensure weed control. Cutting weeds every mid-summer has also been found to help control bracken fern, sweet fern, bayberry, Prunus spp., lambkill, wild rose, and others. Bracken fern should be cut just as the fronds unfold, at least two times, at four to six week intervals. Cutting the tops off weeds can also prevent seed production which could reduce future weed problems. This must be done before seeds ripen. Cutting is, however, labour intensive, and does not generally result in permanent control.

Other practices which may help to control weeds include the use of mulches. Wood chips, sawdust or bark mulch could be used to reduce weed problems, particularly on bare spots within the fields. Planting blueberry plants in bare spots throughout the field also help bare spots fill in more rapidly and out compete weeds.

Preventative methods such as cleaning field equipment such as mowers, harvesters, tractors, winnow machines and boxes would also help prevent the spread of undesirable weeds into previously uninfested fields. The use of biological control agents such as Chrysolina beetle on St. John's wort can also help suppress weeds although the use of this method is not compatible with most insecticides.

Chemical Weed Control

1. HEXAZINONE (Velpar L, Velpar DF, and Pronone 10G).

A. Available formulations of hexazinone

Three commercial formulations of hexazinone are available to lowbush blueberry producers: Velpar L, Velpar DF and Pronone 10G. The older liquid Velpar L contains 240 g/L active ingredient (hexazinone) in an organic solvent base. It's main advantage is it readily goes into solution when mixed with water. However, the solvent was bulky and flammable creating storage and transportation hazards, and it required heated winter storage. These problems are largely solved with the Velpar DF, which is a 75% (active ingredient) dry flowable granule that dissolves in water. Velpar 75 DF is safer and easier to handle, does not require heated storage, and eliminates container disposal problems. The manufacturer's instructions should be followed when mixing to ensure the granules properly disperse and dissolve. Once dissolved in the spray tank, Velpar L and Velpar DF have similar herbicidal activity. On the other hand, Pronone 10G is 10% hexazinone impregnated into a relatively large clay-based granule. The herbicide is released as the granule weathers and disintegrates. This type of release may result in better control with Pronone 10G on light soils where the liquid formulations dissipate sooner. Control may be poor in dry years, especially if applied late. Unlike the liquid sprays, the granular formulation will not cause injury if it contacts foliage and, therefore, is safer when applied later in the season. It is more difficult to properly calibrate granular applicators than herbicide sprayers and to obtain even distribution of granules. Crop injury from Pronone 10G is usually "patchy" and likely indicates uneven granule distribution. A new mini granule formulation has been developed to help improve this distribution. It is generally applied with a calibrated fertilizer spreader, such as the Vicon spreader.

B. Hexazinone in the sprout year

Hexazinone is available in either a liquid (Velpar L), a dry flowable (Velpar 75DF) or granular formulation (Pronone 10G). These hexazinone formulations are all registered for use in lowbush blueberries. Hexazinone is the only soil-applied herbicide that will control woody weeds. The recommended rate is 1.45 to 1.92 kg/ha hexazinone (active ingredient) and is equivalent to 6 to 8 L Velpar L/ha, or to 1.9 to 2.6 kg Velpar 75 DF/ha, or to 14 to 20 kg Pronone 10G/ha.

The above rates applied to prune-year fields will generally give excellent control of such woody weeds as lambkill, hardhack, meadowsweet, Labrador tea poplar and others (Table 1); but some weedy species like bayberry, alder,

false-honeysuckle and witherod are tolerant to the herbicide. Therefore, these rates are useful for bringing new fields into production. Hexazinone at 1.45 to 1.92 kg/ha (active ingredient) will also control most common grasses, sedges and herbaceous broadleaved weeds. Some like quackgrass, vetch, yellow loosestrife and bunchberry are not adequately controlled. Hexazinone dissipates rapidly from soils, particularly where the soils are wet, and some weeds like St. John's wort, sheep sorrel, some grasses and goldenrods can re-establish later in the season even where the herbicide has been used. In practice, lower rates have been used to give maintenance weed control of sensitive herbaceous species in relatively clean fields with a history of hexazinone use.

Hexazinone is applied after the spring pruning operation. Crop tolerance is generally greatest if the herbicide is applied before burned plants emerge or new growth appears on old wood after mowing. Generally there has been little practical difference in tolerance to hexazinone between plants pruned by burning or mowing, provided it is applied at the appropriate stage of crop development. Hexazinone applications made in June can result in serious crop injury. Studies in Nova Scotia have consistently shown that crop injury is due primarily to late application of hexazinone. Some clones and the velvet-leaved blueberry (*Vaccinium myrtilloides*) are sensitive to hexazinone and may have been replaced in fields with a history of hexazinone use. Also plants on sandy or shallow soils, or those weakened by heavy weed competition or frost heaving are more sensitive to herbicide damage than those in vigorous stands.

Although hexazinone can cause severe injury if it is applied directly to the foliage of plants, it is primarily a soil acting herbicide that is leached by rain into the root zone. Herbicide activity can be reduced by either too much or too little rainfall. Its soil activity is also affected by soil texture, that is, lower rates are required on light, sandy soils than on heavier soils or those high in organic matter. Do not apply to gravelly soils, especially those subject to erosion following the removal of weeds, or to steep slopes, or to areas that are wet and poorly drained. It should not be applied to roadways, natural water courses that drain surface water or to other areas subject to erosion in the absence of plant cover. The herbicide is water soluble and subject to leaching and lateral movement. Therefore, it is important to follow Best Management Practices to minimize the risk of contaminating water sources. Overlapping applications, or those made on uneven terrain that does not permit even application, may result in crop injury.

Experience has now shown that the lowbush blueberry does not colonize ground kept bare from repeated hexazinone use. Although hexazinone is an important tool to use in developing blueberry fields, over-use, resulting in bare ground will inhibit the blueberries from "filling-in".

C. Hexazinone in the fruiting year
Application of hexazinone in the fruiting year should only be considered as a harvest aid when there are densities of sensitive weed species that may interfere with the crop harvest or it may be useful in 3-year cropping systems. Remember that fruit buds and stem densities are determined in the sprout year and will not be affected by improved weed control in the fruiting year. Hence, this treatment will affect primarily harvest efficiency and not yield potential.

Apply hexazinone at 1.0 kg/ha (active ingredient). This rate is equivalent to 4.2 L/ha Velpar L, or 1.3 kg/ha Velpar 75 DF or to 10 kg/ha Pronone 10G and will control or suppress goldenrods, asters, sheep sorrel and most grasses. This rate will not control any woody weeds. Timing of application is critical to avoid crop injury and yield loss. Applications should be made in the spring, but no later than the early bloom stage before the flower buds separate and show white petals. This corresponds to floral stages F1 and F2 (bud scales separating) in the *Monolinia* blight control guide. In most areas in Atlantic Canada this occurs on or before mid May. Later applications can cause serious injury and yield reductions. Fruiting blueberry plants do not recover from hexazinone injury like the plants in the sprout year. This treatment should only be applied to soils with a well-developed organic layer and should not be used on sandy or gravelly soils.

2. ATRAZINE (various brand names)

The following atrazine products are currently registered for use in lowbush blueberries: Aatrex L, Aatrex 480L, Aatrex-Nine-0, Atrazine Flowable (Chipman) and Co-op Aatrex Nine-0. Consult the label to calculate the amount of product required to deliver the recommended rate of 4.0 kg/ha (active ingredient).
Atrazine is recommended as a broadcast application for the control of most grasses, sedges and many herbaceous weeds (see Table 1). Atrazine is residual in the soil and will prevent many weeds from establishing from seed. Atrazine will generally give superior weed control to Sinbar. However, Atrazine, unlike Velpar, does not control any of the common woody weeds found in lowbush blueberry fields. Therefore,

Atrazine is recommended only in fields that are relatively free of woody weeds, but may be infested with a mixture of grasses and broad-leaved weeds.

Atrazine should only be applied in the spring after the pruning operation, but before blueberry shoots emerge. Applied in this manner, Atrazine has proven safe on the crop. Late applications made directly to emerged blueberries can cause serious crop injury. On soils with organic matter content greater than 10%, weed control has been erratic, especially for asters and goldenrods. Avoid applying Atrazine to coarse textured soils low in organic matter, or to rocky uneven terrain that does not permit accurate application or to areas that are wet or poorly drained. Steep terrain that may be subject to erosion following control of weedy vegetation should not be treated.

When using the liquid Atrazine, it is important to use nozzle screens not finer than 50 mesh size and a nozzle size of 8003 or equivalent. Furthermore, the bypass line should be kept at or near the bottom of the tank to minimize foaming. Apply the herbicide at 200 kPa pressure and use a spray volume of 200 to 350 L water per hectare.

3. ROUNDUP, ROUNDUP TRANSORB, TOUCHDOWN 480 and GLYFOS (glyphosate)

There are currently four products containing glyphosate registered for use in lowbush blueberries, Roundup, Roundup Transorb, Touchdown 480, and Glyfos.

Roundup, Roundup Transorb, Touchdown 480, and Glyfos has a place in land clearing and the preparation of fields for blueberry production and also as a spot treatment in established fields. Roundup/ Roundup Transorb/ Touchdown 480/ Glyfos can only be used in blueberries if it is selectively applied to the weed foliage. Blueberries are very sensitive to glyphosate treatments and contact with the herbicide will result in damage to the blueberry plants.

Roundup, Roundup Transorb, Touchdown 480, and Glyfos is absorbed into the foliage and translocates throughout the plant killing both above and below ground growing points. It is generally most effective applied in June through August to fully expanded and actively growing foliage.

Roundup, Roundup Transorb, Touchdown 480, and Glyfos is effective against most broad-leaved species including maple, beech and ash. It is not effective as a stump or bark treatment because it does not readily penetrate mature bark.

Roundup, Roundup Transorb, Touchdown 480, and Glyfos has no activity when applied to the soil and gives no residual weed control.

Roundup/ Roundup Transorb/ Touchdown 480/ Glyfos can be applied selectively either as a directed spot spray or as a wiping treatment. As a spot spray apply a 1 to 2% solution of Roundup/ Roundup Transorb/ Touchdown 480/ Glyfos to the foliage of woody weeds in the sprout year (a 2% mix is equivalent to 2L of product in 100L of water). Ensure uniform coverage and apply enough product to wet the leaves but not to the point of runoff.

Wiper and roller treatments are also effective. For roller applicators, mix 0.5 to 1.0L of Roundup/ Roundup Transorb/ Touchdown 480/ Glyfos in 10L water to prepare a 5 to 10% solution. Roller speed should be maintained at 50 to 150 rpm.

For Wick or other wiper applicators, mix 1L of Roundup/ Roundup Transorb/ Touchdown 480/ Glyfos in 2L of water to prepare a 33% solution. Most herbaceous and woody weeds with the exception of conifers are sensitive to glyphosate.

Consult the label for additional information on the use of these products.

4. SPARTAN (Tribenuron methyl) **+ Agral 90**

A. Spartan broadcast applications for bunchberry control

Spartan 75DF is registered for bunchberry control in wild blueberries. It is a post emergent herbicide that is only effective if applied to the foliage. Proper application timing is critical with the use of this herbicide and will directly influence the level of bunchberry control and crop injury.

To control bunchberry, Spartan 75DF must be applied at 40 g/ha with 0.2% v/v Agral 90 (2 L Agral 90 per 1,000 L of water) in the spring of the sprout year. It should be applied in 150 to 250 L of water per hectare.

For best results, applications should be made when the majority of the emerged bunchberry plant leaves have unfolded to form a 45 degree angle, but no later than when the first white blossoms are visible on the most advanced plants. Bunchberry plants generally turn pinkish red to yellow following spraying but may take weeks to die down. If Spartan 75DF + Agral 90 applications are made too late, bunchberry plants turn red and remain so for the entire

season and reduced control can then be expected. If Spartan 75DF + Agral 90 is applied too early, bunchberry regrowth can be expected later in the season.

In the year following Spartan 75DF application, some bunchberry regrowth can be expected, but densities will be much lower. It may be necessary to use Spartan 75DF in following sprout years to maintain the control of bunchberry.

Spartan 75DF + Agral 90 should be applied before blueberry sprout regrowth exceeds 2 cm in height. However, some stem height reduction with some yellowing and reddening of the blueberry leaves might be observed for 6 to 8 weeks after application. Applications made at later stages of blueberry development or applications in spring-burnt fields are **not** recommended due to potential crop injury and yield reductions. Blueberry plant stunting can result following Spartan 75DF + Agral 90 application, but they recover and fruit bud numbers and yields are not affected. Recommended fertilizer applications before or after Spartan 75DF + Agral 90 applications can be beneficial. Spartan should preferably be applied the same day as mixing in order to achieve maximum performance.

When used in the manner described above, Spartan 75DF has generally resulted in "good" to "excellent" control (70 to 90%) of bunchberry in fields with minimal effect on the crop. In a few cases, control and crop injury has been erratic for unknown reasons.

B. Spartan spot application

Spartan 75 DF can also be applied as a directed spot spray with a backpack, hand-held sprayer, or handgun to control several important weeds with little risk of crop injury. Apply Spartan 75 DF at 0.25g per liter of water with 0.2% Agral 90, a surfactant, as a directed spray for the control of yellow loosestrife, bracken fern, wild rose and speckled alder. This rate is equivalent to 25 g product and 200 mL Agral 90 in 100 L of water. Applications should be made in mid summer of the sprout year to fully expanded foliage of bracken fern and yellow loosestrife, but wild rose and alders that retain their foliage longer can also be controlled with late summer or early fall applications. There are few obvious symptoms on bracken fern treated with Spartan 75 DF spot sprays in the year of application, but control in the year after is excellent. The other sensitive weed species show stunting, chlorosis and reddening of the foliage and the growing tips will turn necrotic after application. Apply the spray to thoroughly wet the weed foliage. Spraying the blueberry plants directly may cause some stunting and affect flower

buds, but generally these weeds can be controlled with little or no crop injury with careful application. Control of some species has been erratic, e.g. poplar, willow, red maple and fly honeysuckle; and many others are highly tolerant to this herbicide, e.g. barrenberry, bayberry, black bulrush, sweet fern, and birch. Once Spartan is mixed in water it should preferably be applied the same day in order to provide maximum performance.

5. FUSILADE II (fluazifop-p-butyl)

Fusilade II is registered for postemergence control of quackgrass and poverty oatgrass but can be applied only in the non fruiting (sprout) year. Apply Fusilade II at 2 L/ha (250 g active ingredient/ha) when the majority of quackgrass shoots have 3 to 5 new leaves. It has little or no soil activity and is effective only when applied directly to actively growing foliage. It should not be applied within two hours of a rainfall. Fusilade II is highly selective and safe on the crop and has no known activity on any broadleaved weeds, or on sedges and rushes. The effectiveness of Fusilade II on many of the other native grass species that occur in lowbush blueberries, such as bluegrasses is not well documented, and consequently control of other species may be poor.

6. SIMAZINE

Clean Crop Simazine 80WP (1.7 to 2.25 Kg/ha) and Princep Nine-T (1.5 to 2.0 kg/ha) are registered for use in lowbush blueberries. These herbicides should be applied in a water volume of 300 L/ha. Historically these herbicides have not been used very frequently. As a result the weed spectrum controlled by these herbicides is not well documented. Woody weeds will not be controlled with Simazine.

Clean Crop Simazine and Princep Nine-T can be applied in late fall to early spring when blueberries are still dormant. Only one application is permitted per season. The lower rates are to be used on the sandier soil types. Crops are not to be harvested within 60 days of treatment application.

7. SINBAR 80 WP (terbacil)

Sinbar at 1.5 to 2.5 kg product per hectare (1.2 to 2.0 kg/ha active ingredient) should be applied in the spring, after the pruning operation, but before blueberry plants emerge. Later applications may result in crop injury.

Sinbar is primarily effective against grasses and hay-scented fern. It is generally not recommended to be used alone as an

overall application because this use will strongly promote goldenrods, asters, sheep sorrel and other tolerant broad-leaved weeds. To control hay-scented fern apply a foliar application of Sinbar at 250 g in 250 liters of water sprayed almost to the point of run-off.

BANVEL (dicamba)

Banvel is a non-selective broadleaf herbicide which when applied to the foliage, is absorbed by the leaf and translocated throughout the plant.

Banvel can be applied alone or in combination with 2, 4-D L.V. Ester as an overall broadcast or as a spot spray. It is important to remember that Banvel or Banvel plus 2, 4-D can cause serious damage to lowbush blueberries if applied directly on the actively growing blueberry plants or if improperly applied.

For control of lambkill (sheep-laurel) and suppression of sweet-fern apply Banvel (480 g/l a.i.) at a rate of 4.6 to 7.1 litres per hectare. Application must be made in the fall while the target weed is still moderately green but after 90% of the blueberries have dropped their leaves. Fall pruning should be carried out 4 to 5 weeks after spraying. If spring pruning is followed, it should be done as early as possible to reduce injury to the blueberry plants.

In site preparation, Banvel can be used as a spot spray to control Velpar resistant weeds such as maple, alders, willows and honeysuckle. As noted above, contact with actively growing blueberry plants should be avoided.

9. GARLON 4 (triclopyr)

Registered for use as a stump and basal bark treatment to control woody weeds during wild blueberry field site preparation. Avoid any spray contact with emerged blueberry plants as severe injury will result. Garlon 4 should be useful on newly cleared sites against such species as alder, ash, birch, poplar, chokecherry, and maples. Chokeberry and red maple are more difficult to control and may require retreatment the following year, particularly if lower rates were initially applied. Only 1 application of Garlon 4 per year is permitted.

Two methods of applying Garlon 4 are recommended and can be applied using a backpack sprayer. One uses the " Conventional" volume where 1 to 5L of Garlon 4 is mixed with enough oil to make 100L of spray solution. The oil can

be diesel, kerosene, fuel oil, or mineral oil. This solution is applied as a spray at any time of the year to the bottom 50 cm of trees up to 15 cm in diameter, as well as to any roots or root crown that may be exposed. The second recommended treatment involves a "concentrated" solution of 20 to 30L of Garlon 4 mixed up in oil to make 100 L of spray solution. This is applied to the cut surface, sides and exposed roots of stumps. Careful application is essential to avoid crop injury. Garlon 4 should never be applied as a foliar spray in lowbush blueberry fields. Refer to the label for additional information.

METHODS OF APPLICATION

There are various methods of applying herbicides to unwanted vegetation. One should choose the method which best suits the conditions and available equipment. When herbicides are mentioned below, be sure to read the information about them in the previous section and all of the information provided on the label.

To avoid damage to the blueberry plants, herbicides must be applied at the recommended rate.

Overall Broadcast Spray

Overall broadcast spraying is done employing a boom sprayer. Irregular spray applications can be avoided by the use of flagging tape, foam markers or the use of an appropriate dye. To apply the herbicides at the recommended rate the equipment must be calibrated and in proper working order.

An overall broadcast spray is recommended for treating large infestations of lambkill or sweetfern with Banvel or entire fields after the pruning operation with one of the residual soil-applied herbicides such as Velpar or Atrazine. Pronone can also be applied as a broadcast application using a granular applicator such as a Vicon spreader.

Foliar Applications on Brush

Unless otherwise stated on the label, applications should be limited to bushes that are less than 2 meters in height. If bushes are higher, cut and treat the regrowth. Foliar applications are generally the most effective just after full leaf development in late spring or early summer. Applications made to actively growing bushes will be the most effective if good growing conditions and adequate soil moisture are present. Under those conditions applications may be made up to 2 or 3 weeks before the normal frost date.

Coverage should be uniform and thorough to wet all leaves, stems and root collars. Mix with water only and spray until wet, but avoid spraying to runoff. Extreme caution must be used as any spray contacting blueberry plants can cause severe injury or death. The use of herbicide wipers and rollers can also be useful for applying herbicides to the foliage and stems of species that grow above the crop.

Stump Treatment (site preparation only)
Unless otherwise stated on the label, the herbicides used for stump treatment should be applied in diesel oil, fuel oil, kerosene, or mineral oil to help penetrate the exposed bark and cut surfaces (environmentally, mineral oil is the preferred choice). This treatment is useful in that it can be applied any time of the year, including the winter months as long as snow or water does not prevent spraying. Unless otherwise stated, applications should be made to freshly cut stumps. Best results are usually obtained on stumps 5 cm across or larger (refer to individual labels). All exposed bark, roots, and cut surfaces should be wet thoroughly either by painting or spraying. For old stumps it is best to drill several holes or split the stump with a wedge before applying the treatment. Dye can also be added to the mixture to help ensure that all exposed surfaces of the stump have been treated, and stumps do not get retreated or skipped. Trash from brush cutting operations such as sawdust, leaves, branches, etc. should be removed from the base of the stumps before treating. Care must be taken to ensure that all cut stems in a clump have been treated, or regrowth can result. Most of the stump treatments will control the top growth of root suckering species (i.e. poplar, and aspen), however, regrowth from lateral roots may occur the following season.

A stump treatment is a safe and effective way of controlling bushes and small trees. Here 2,4-D (low volatile ester formulation) is mixed at a ratio of 2.0 kg active ingredient in 100 L fuel oil and either sprayed or painted on to freshly cut stumps and exposed roots. Most woody weeds are affected by this treatment, and on certain species, stump treatments are more effective than 2, 4-D applied directly to foliage. Stump treatments can be applied at any time of the year the weeds are cut, and crop damage can be minimized by careful application. Killing the stump encourages it to rot. If new regrowth appears following these treatments, it should be treated with an appropriate herbicide. Note that 2, 4-D is registered for general weed control and used in preparing land for blueberry production. This product is not registered for use in blueberry fields and can cause crop damage if applied directly to the blueberry plants.

Basal Bark Treatments
Brush and small trees (15 cm diameter) can be controlled by spraying or wiping the basal parts of bush stems and tree trunks from the ground line up to a height of 50 cm or as recommended on the label. Treatments are applied in diesel oil, fuel oil, kerosene or mineral oil as recommended on the label (environmentally, mineral oil is the preferred choice). The 2,4-D and fuel oil mixture described above can be used as a basal bark treatment.

Old or rough bark requires more volume than young or smooth bark. Treatments can be applied any time of the year except when snow or water prevent spraying at the ground line. Basal Bark treatments are advantageous because the entire bush or tree foliage does not require spraying. If spraying, use a nozzle that forms a very narrow band or stream.

The basal bark treatment is useful against a wide range of trees and brush with trunk diameters up to 15 cm.

Spot Sprays
Spot spraying applies herbicide to the foliage of weed species, avoiding contact with the blueberry foliage. Depending on the product used and the time of application, blueberry plants can be injured or killed if the foliage is sprayed. Applications are often made in the summer of the sprout year, but these can result in crop injury. Alternatively, evergreen species, such as lambkill and bayberry, can be sprayed with Banvel in the fall (see Notes on Herbicides). Furthermore, many species such as alders, sweetfern, bayberry, blackberries retain their leaves in a viable condition longer than the harvested blueberries and can be treated in October with Banvel.

Spot sprays can be applied with either backpack sprayers or by operating a handgun from a line connected to a tractor mounted sprayer.

Wiping Treatments
Wiping and rolling methods can be used where weeds are taller than the blueberries. A commercially available Ahockey-stick@ applicator has been used effectively for applying Roundup.

There are several roller-type applicators now in use, including several tractor mounted models and small one-man portable machines for use in small fields. The herbicides is slowly delivered to a rotating drum, with an absorbent

covering, that wipes the foliage of tall weeds and bushes, transferring the herbicide from roller to leaves. In order to avoid misses most rollers must be operated relatively slowly.

TABLE 1

WEEDS CONTROLLED WITH VELPAR

GRASSES (Including sedges and rushes)

Kentucky bluegrass	Witchgrass	Wood rush*	Sweet vernal grass
Soft rush	Browntop	Poverty oat grass	Hair fescue
Black sedge	Creeping bentgrass		

BUSHES AND SHRUBS

Bristly sarsaparilla	Willow*	Trailing blackberry*	Wild raspberry
Sheep laurel (lambkill)	Hardhack	Rhodora	Meafow-sweet
Birch	Poplar		

OTHER WEEDS

Tall white aster	Stitchwort	Purple aster	Wild strawberry
Mouse-eared hawkweed	Sheep-sorrel	King devil hawkweed	Orange hawkweed
Rough goldenrod	Cow wheat*	Canada goldenrod	Narrow-leaved goldenrod
Large-leaved goldenrod	Yarrow	Fireweed	Pearly everlasting
Five-fingered cinquefoil*			

WEEDS CONTROLLED BY ATRAZINE**

GRASSES

Creeping bentgrass	Kentucky bluegrass	Hair Fescue	Browntop
Swett vernal grass	Witchgrass	Poverty oatgrass*	

OTHER WEEDS

Large-leaved goldenrod*	Wild strawberry	Stitchwort	Yarrow*
Mouse-eared hawkweed	Orange hankweed	Rough goldenrod	Narrow-leaved goldenrod
King devil hawkweed	Canada goldenrod	Purple aster	
Five-fingered cinquefoil*			

WEEDS NOT CONTROLLED BY ATRAZINE OR VELPAR

Hayscented fern	Bulrush	Bracken fern	Bunchberry
Wild lily-of-the-valley	Witherrod	Barrenberry	Sweet fern
St. John's wort	Tufted vetch	Yellow loosestrife	Pin cherry
Spreading dogbane	Wild rose	Bayberry	Lion's paw
3-toothed cinquefoil	Speckled alder	Teaberry	

This table is provided as a guide only. Control will vary depending on the conditions in the field. This table is not an intended as an endorsement of any specific product. Not all weeds are listed in the table. For a more complete list of weeds controlled with these products, see "Weeds of Eastern Canadian Blueberry Fields".

* denotes variable control
** due to revised rates for Atrazine, weed control may be variable.

Poison Control Centres

New Brunswick	Dial **911** and ask for Poison Information
Newfoundland	Dr. Charles A. Janeway Child Health Care Centre, St. John's Telephone: 722-1110
Nova Scotia	The Izaak Walton Killam Hospital for Children, Halifax Telephone: 428-8161, 1-800-565-8161
Prince Edward Island	The Izaak Walton Killam Hospital for Children, Halifax Telephone: 1-800-565-8161

Environmental Emergencies (Pesticide Spills)

Transport Canada Regional Operations Centre (24 hours)

New Brunswick, Nova Scotia and Prince Edward Island	1-800-565-1633
Newfoundland	1-800-563-2444

Abbreviations and Helpful Conversions

	millilitres X 0.035 = fluid ounces
hectares X 2.47 = acres	litres X 35 = fluid ounces
kilograms X 2.2 = pounds	litres X 0.22 = imperial gallons

kilograms per hectare X 0.89 = pounds per acre
kilograms per hectare X 0.40 = kilograms per acre
litres per hectare X 14.17 = fluid ounces per acre
litres per hectare X 0.40 = litres per acre

Prepared by: The Atlantic Committee on Fruit Crops